Waste Reduction Activities at the Los Alamos Compactor Operations

Alicia L Hale
Environmental Stewardship Office (ESO)

Background

Solid radioactive wastes are segregated, collected, and stored at the point of generation in large metal "dumpsters" (capacity of 180 cu. Ft). The waste is first collected in plastic bags or cardboard boxes within the generator's facility before loading into the waste dumpsters. Once the dumpster is filled, it is transferred to a storage area at TA-54 using a dedicated haul truck with a special lifting apparatus.

Los Alamos National Laboratory installed a high-force (200-ton) box compactor in 1997. Compaction reduces the effective waste volume of solid radioactive wastes by removing interstitial void spaces between the contaminated paper, plastic, and wood in the waste. Compaction is capable of achieving a 5 to 1 volume reduction for most of the Laboratory's solid radioactive wastes. However, this process generates secondary waste (such as cardboard, paper, spill clean-up materials, and protective safety equipment) and various Integrated Safety Management Issues (ISM). The focus of this project is to evaluate compacting operations and identify pollution prevention opportunities. This project also examined potential benefits to waste generators of optimizing compactor operations.

This report documents Los Alamos National Laboratory's application of the Green Zia Tools as specified in Functional Area 3 (Managerial Accomplishments) of Section B, Part II-1, Appendix F of the DOE/University of California contract (1999). The Green Zia analyses were accomplished according to New Mexico Green Zia Environmental Excellence Award program guidance http://www.nmenv.state.nm.us/.

The Challenge

Loading the dumpsters for transportation to the compactor has associated operational inefficiencies such as putting the waste into cardboard boxes before placing it into the dumpsters. Each dumpster holds several cardboard boxes and each cardboard box has an identification number that requires paper work before the dumpster can be transported to the compactor facility. This results in generation of significant quantities of cardboard and paper waste.

Unloading the dumpsters at the compactor facility and placing the waste packages in the compactor also have several operational inefficiencies associated with waste materials handling. Current methods for unloading the waste result in individual packages being handled multiple times and require workers to bend and to lift materials into the compactor container. The inability to stage adequate amount of waste inside the compactor facility requires personnel to exit and reenter multiple times. Each exit and reentry requires additional personnel protective equipment (PPE) changeouts.

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In addition, rainwater occasionally collects in the storage dumpsters resulting in spills of potentially contaminated water when the dumpster is emptied. Clean-up operations associated with rainwater spills in the compactor facility increase the amount of secondary waste generated. The challenge was to reduce these inefficiencies and thus reduce the waste.

Compactor personnel decided to meet this challenge by applying the Green Zia systems approach to address these issues. This paper will explore how a team was formed and how this team used the following tools to address issues involved in the compaction process:

- Determining opportunities in the current process using process maps
- Rank ordering of the opportunities to improve the process using Pareto analysis and activity-based costing
- Determining the root cause of the selected opportunity using a cause and effect (fishbone) diagram
- Posing a consensus problem statement for generating process alternatives
- Generating process alternatives using a brainwriting tool
- Selecting an alternative using bubble-up/bubble-down (forced pairs comparison)
- Implementing the selected alternative with a formal action plan.

Green Zia Compaction Team

A multi-disciplinary team was formed to address the improvement of the compactor process. Participants on this team include people familiar with the compaction process. The following individuals were members of this team:

- Phil Grogin, health and safety engineer
- Alicia Hale, Green Zia Tool specialist
- Andres Lopez, laborer
- John Loughead, systems engineer
- Phyllis Maestas, radiation control technician
- Tim Martinez, compactor technician
- Kirk Meekin, industrial hygienist
- Marty Mitchell, quality assurance
- Andrew Vigil, dumpster truck operator
- Art Vollmer, waste management specialist
- Jeff Weinrach, facilitator
- Karri Wilder, waste acceptance specialist.

This team met on several occasions to complete the work on this project.

Process Characterization

The team prepared process maps for the compaction operations (see Figures 1-4). Figure 1 is a top-level map that displays the compactor's six main work steps: fill dumpster; transport/store dumpster; empty dumpster; load waste into compactor, compact, and return the dumpster to the customer. Figures 2 and 3 displays a breakdown of the top level map into a more detailed map for work step empty dumpster and load waste into compactor (3.0).

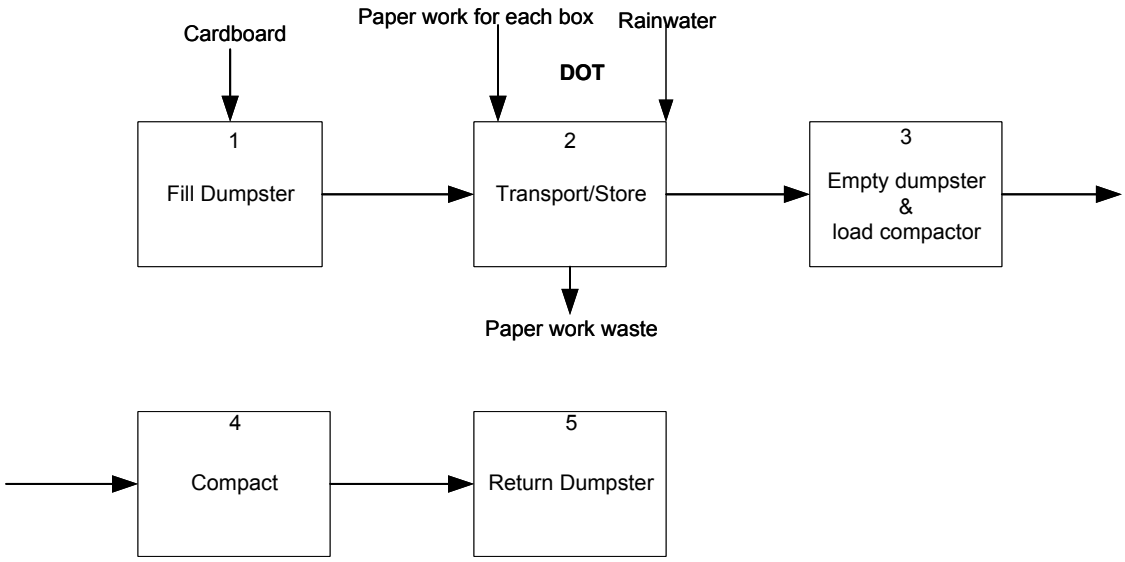

Figure 1. Top Level Process Map for Compacting Operations

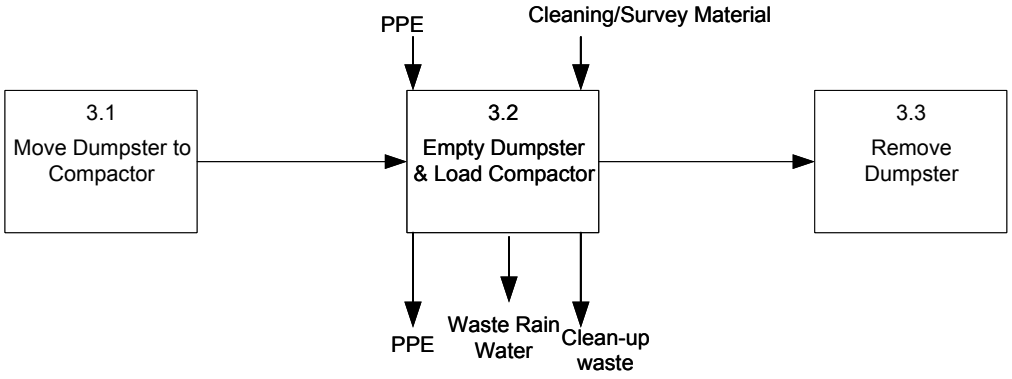

Figure 2. A Detailed Map for 3.0 Empty Dumpster and Load Compactor

Figure 4 illustrates ancillary work steps of pre-operational activities (2.0) and post-operational activities (5.0). Ancillary processes occur daily to assist the overall compacting operations. It is crucial to analyze these operations because they can generate waste. The pre-operational and post-operational activities are considered ancillary operations because they are processes that support the main operation of compacting. They are important because the compactor operators' can not compact or end compaction without completing the pre-operational and post-operational activities.

The arrows at the top of the work steps are the material inputs (such as "rainwater" in work step 2.0), and the arrows at the bottom of the work steps are the material losses (such as "waste rainwater" in work step 3.2). Usually, material uses and losses are portrayed during the breakdown of the top-level map, however, work steps fill dumpster (1.0) and transport/store (2.0) are not broken down so the material uses and losses are illustrated at the top-level map.

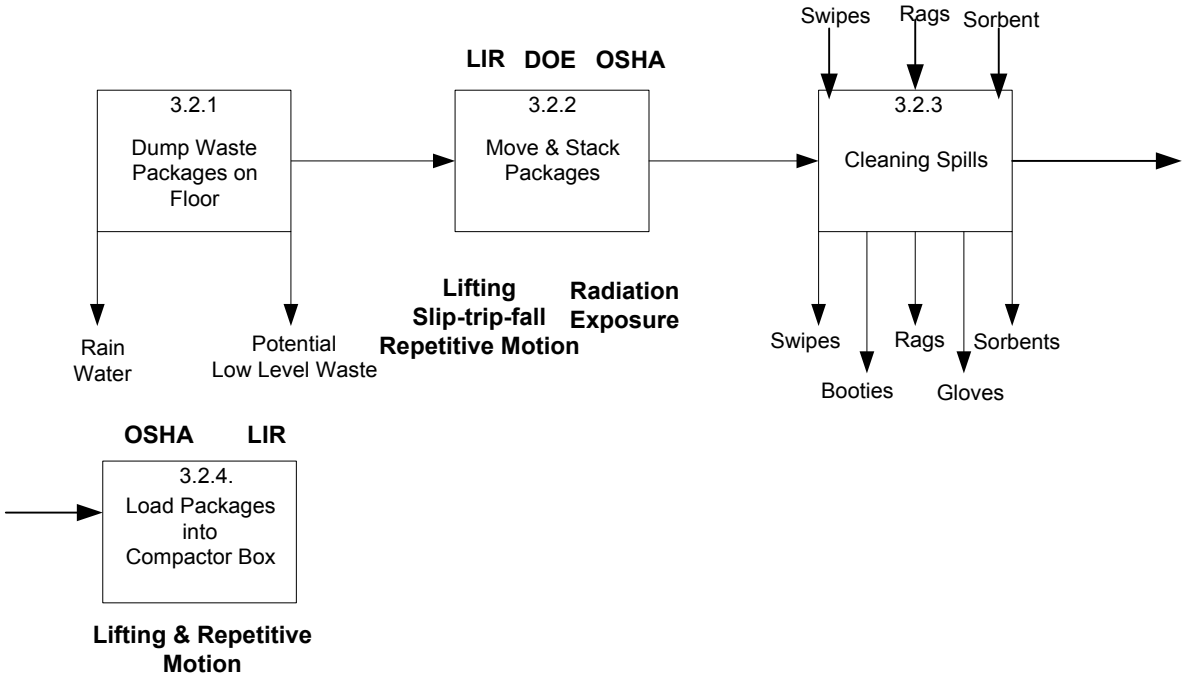

Figure 3. Detailed Process Map for 3.2 Empty Dumpster and Load Compactor

Figure 4. Ancillary Process Maps for 2.0 Transport/Store and 5.0 Return the Dumpster

These figures represent only a portion of the process maps prepared by the team. However they are the most important for the purpose of this report.

It is beneficial to assess the compactor operations with the process maps; they provide an integrated view of environment, health and safety issues (**they are in bold**). Process maps are valuable because they enable the compactor team to assess health and safety issues for each work step. Furthermore, the team can use the maps to determine what work steps contribute to operational inefficiencies. For example, the team used the maps to determine that the compactor's operational inefficiencies occurred during the work steps of transporting /storing the dumpster (2.0) and empty dumpster and loading the compactor (3.0).

Rank Ordering of Opportunities

To better understand the compaction issues, the team worked to identify the cost factors associated with handling the waste packages inside the compactor facility (see work step 3.0). The following table shows the items for which estimated costs were prepared.

COSTS FACTORS IDENTIFIED FOR ACTIVITY-BASED COSTING		
Labor	Materials	Overhead
time spent handling waste packages time spent donning and doffing PPE	gloves and booties sorbent for spills rags for spill cleanup radiological smears dumpster truck use fees disposable coveralls respirator cartridges ear plugs cold packs	safety & health support health physics support support for off-normal situations (e.g., spill response) safety & health training PPE & respirator training Occupational medicine physicals

Figure 5. Activity Based Costing

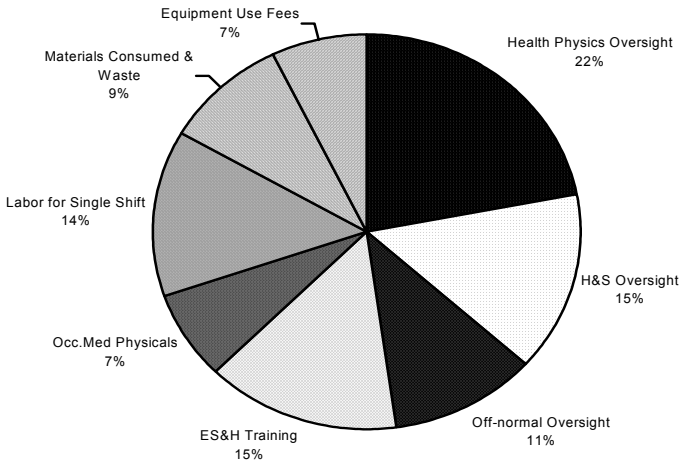

Figure 6. Pie Chart Depicting All Direct and Indirect Costs for the Compacting Operations

The costs for indirect labor and materials were relatively easy to determine from operating logs, invoices, other facility records, and operating experience. However, the overhead charges were not readily available because they are not normally costed at the activity level. To complicate matters, compactor personnel are not dedicated full-time to this equipment. Therefore, it was necessary to generate estimates based on a portion of the facility-wide overhead costs for environment, safety and health oversight, medical costs, and training. Figure 6 shows percentages for the major cost factors for compaction activity. Direct charges account for about one-third of the total cost according to the team's estimates. These costs could be further distributed to the sub-work step activities. This would allow for the individual activities to be ranked by cost so that the most costly activities can be targeted for further analysis and subsequent improvement. It is interesting to note that indirect materials/waste costs accounted for 9 percent of the total cost.

It is clear that any savings gained by making operations more efficient or reducing the need for oversight support and use of personnel protective equipment (PPE) would contribute to the overall savings associated with reducing new waste by revamping the waste dumping/compactor loading operation.

Root Cause Analysis

For this study, the team examined the issues associated with the waste loading activity with a cause and effect diagram to identify potential contributing causes of the problem. This diagram is shown in Figure 7. The team focused on several of the causes as being more significant such as the compactor facility is too narrow with limited storage space so it is difficult to move boxes around within the facility, current dumpsters do not have effective water tight closures, bottom-opening dumpster design only allows for all-or-nothing unloading, and inability to stage adequate amount of waste inside compactor facility results in multiple exits and entrances, which require additional PPE changeouts. These main causes are circled in Figure 7.

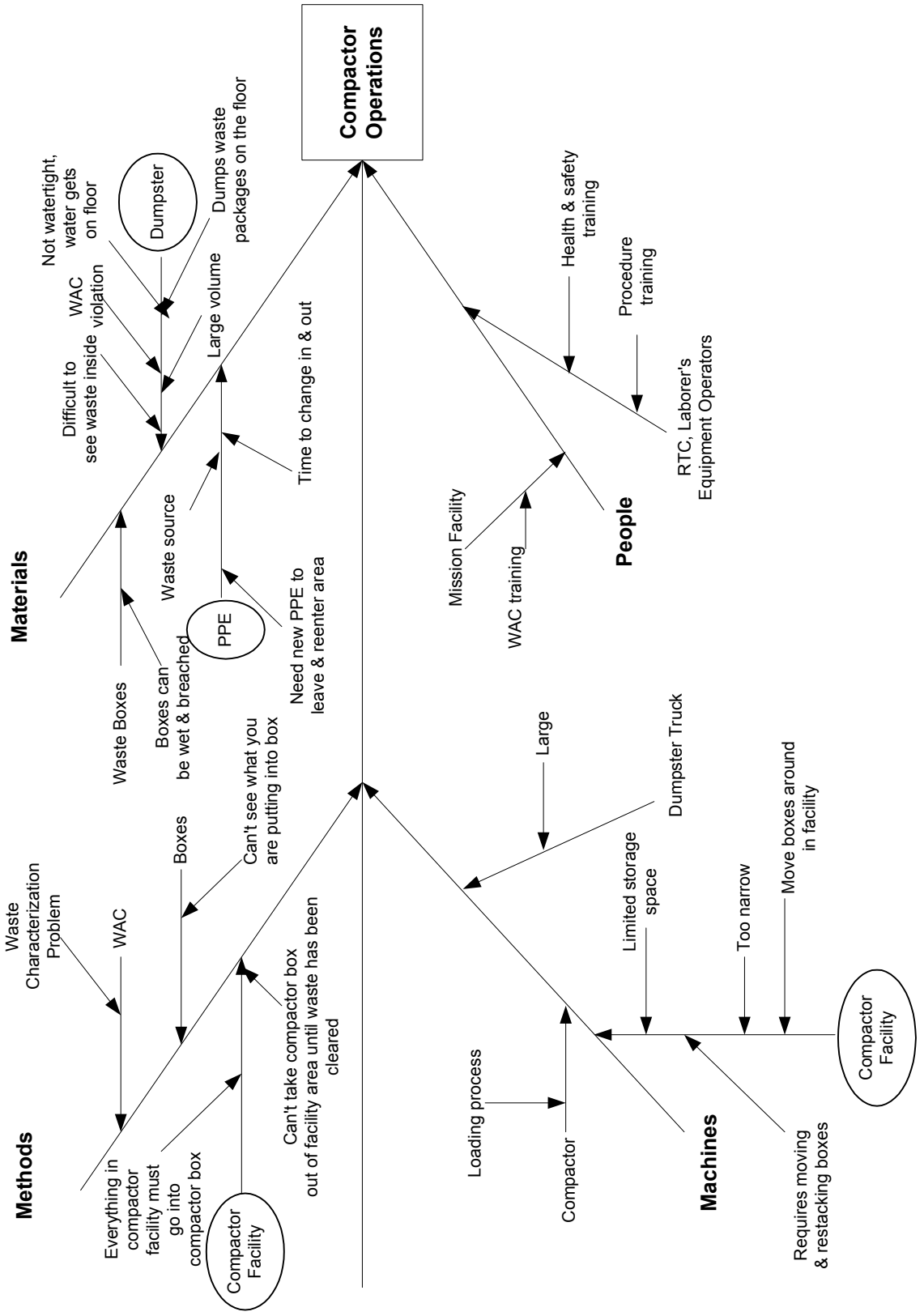

Figure 7. Cause and Effect Diagram for Compactor Operations

Statement of Problem

The team prepared a problem statement that outlines the major issues of concern and identified the suspected root cause(s). See Figure 8 for the statement of problem.

To: John Loughead
From: TA 54 Compactor Operators
Date: September 20, 1998
Re: Compactor Operations Concerns

The loading sequence for the compactable waste is creating a significant concern because we lack enough space within the compactor facility to efficiently load the waste into the compactor. After our team examined materials, methods, machinery, and people that could affect the loading operation of the compactor we identified the following areas as primary contributors:

- Space restrictions and current equipment cause difficulties associated with unloading sequence for dumpster waste and limit operational alternatives for managing waste on the compactor facility floor.
- Significant time is spent avoiding potential slip/fall/trip hazards and in handling waste packages multiple times.
- Current dumpsters do not have effective water tight closures and, this allows rainwater to enter during storage.
- Bottom-opening dumpster design only allows for all-or-nothing unloading.
- Inability to stage adequate amount of waste inside compactor facility results in multiple exits and entrances, which require additional PPE changeouts.
- Work procedures for filling the dumpster requires excessive paperwork and cardboard.

We feel that the problem results in avoidable inefficiencies that can be eliminated or mitigated by reconfiguring the process of how waste packages are unloaded at the compactor facility. We request approval to continue further study of the problem to come up with a potential solution to address the issues identified above.

Figure 8. Problem Statement

Generating Process Alternatives

A brainwriting tool was used to generate a large listing of possible alternatives from the team. The alternatives that resulted from this activity are as follows:

A. Use 55-gallon drums instead of dumpsters to collect waste packages; compact whole drums.
B. Build a larger compactor facility.
C. Take down compactor facility and operate with the protective dome as only containment.
D. Replace current dumpster with smaller dumpster.
E. Make dumpsters water tight).
F. Use compactor boxes instead of dumpsters.
G. Use fiberboard boxes to collect waste packages; compact entire box.
H. Replace dumpster with smaller, moveable water tight container.
I. Stop using compactor; dispose of waste “as is.”
J. Use washable instead of disposable PPE.
K. Create separate areas for dumping waste and compacting waste to avoid congestion in front of compactor.
L. Require generators to transport (and unload) their own waste packages.
M. Have generators only half-fill dumpsters.
N. Place dumpsters in enclosed areas at generator sites so rainwater will not get inside.
O. Have one identification number per dumpster.
P. Stop using cardboard boxes in dumpsters.

Selecting an Alternative

The team using a bubble-up/bubble-down tool prioritized these alternatives. To better prioritize the alternatives, the team used the criteria of effectiveness, ability to implement, and cost. The team aggregated similar alternatives. The list in priority order includes:

1. Use a different collection container (A, F, G, O, P, H);
2. Redesign dumpster (D,E);
3. Revise waste collection process (I,M,N);
4. Redesign compactor facility (B,C,K);
5. Use washable PPE (J); and

6. Stop compacting waste (I).

Action Plan

The team decided to implement the alternative of using a different collection container. An action plan was prepared by the team with detailed steps on how to implement the chosen alternative. These steps are listed below.

System Configuration/Modification:

- Finalize waste box design (9/24/98)
- Perform ergonomic evaluation (10/5/98)
- Prepare specifications package for procurement (9/24/98)
- Procure waste boxes (10/30/98)
- Select waste box transport option (10/15/98)
- Prepare vehicle specifications for procurement (10/30/98)
- Procure transport vehicle (10/30/98)

Authorization Basis:

- Prepare unreviewed safety question documentation for procedure revision (11/15/98)

Procedures:

- Revise compactor procedure (DOP-54G-017) (11/15/98)
- Walkthrough revised procedure (11/16/98)

- Finalize compactor procedure (11/20/98
- Update radiation work permit (11/30/98)

Training:

- Revise lesson plan. (11/20/98)
- Revise qualification standard. (11/20/98)
- Revise TES. (11/20/98)
- Provide training to candidate staff (11/30/98)
- Evaluate training per TES (1/31/99)

Performance Measures

- Conduct continuous process improvement surveys to all people (generators, operators, and transportators) impacted by the white laundry boxes. What would be included in this survey is the levels of satisfaction people have with the boxes (05/99-12/01).
- Number of people who request the boxes (09/99-12/01).
- Measure the volume and purchasing costs of the PPE before and after laundry boxes (with the dumpsters, multiple changes of PPE occur because employees leave have to leave compactor facility areas multiple times, new boxes means employees no long have to leave facility) (09/99-12/02)
- Estimate labor time before and after boxes (For example, before the boxes, we spent 80% of our time preparing the waste for compaction, now we spend 20% for preparation and 80% for compacting) (12/99-12/02).
- Measure number of water spills before and after boxes (ISM concern) (09/99-12/02).

- Measure reduction in usage of paper work, cardboard, and spill clean-up material (09/99-12/02).

Status
As of July 1, 1999, the Laboratory's Solid Waste Operations group has deployed these boxes in two facilities. The group's goal is to continue to pilot these boxes throughout the Laboratory.

For additional Information about the compactor study or the Green Zia Program at LANL, please contact Tom Starke with the LANL Environmental Stewardship Office.

Electronic Mail Address: tps@lanl.gov
Phone Number: 505-667-6639
Mailing Address: EM-ESO, MS J591
Los Alamos National Laboratory
Los Alamos, NM 87545